Open Access Publish Free

http://jept.ir
doi 10.34172/jept.2024.17

Journal of Emergency Practice and Trauma
Volume 10, Issue 1, 2024, p. 7-16

Original Article

A study on abdominal emergencies presenting during COVID-19 at a tertiary care center in Central India

Vishnu Vardhan P. Reddy[1], Srujan Dharap[1], Reyaz Ahmad[2], Ajeet Maurya[1], Meena Kumari[1], Bharati Pandya[1*]

[1]Department of General Surgery, All India Institute of Medical Sciences, Bhopal, India
[2]Department of Pediatric Surgery, All India Institute of Medical Sciences, Bhopal, India

Received: November 13, 2023
Accepted: February 27, 2024
Published online: May 7, 2024

***Corresponding author:**
Bharati Pandya,
Email: bharati_pandya@rediffmail.com

Citation: Reddy VVP, Dharap S, Ahmad R, Maurya A, Kumari M, Pandya B. A study on abdominal emergencies presenting during COVID-19 at a tertiary care center in central India. Journal of Emergency Practice and Trauma 2024; 10(1): 7-16. doi: 10.34172/jept.2024.17

Abstract

Objective: COVID-19 caused one of the most prolonged global pandemics, disturbing the routine of hospital protocols beyond measure, especially affecting surgical specialties, emergencies, and cancer care.

Methods: This observational study was conducted on 129 patients of pediatric and adult age groups who presented with abdominal emergencies from March 1, 2020 to March 31, 2022 and were recruited for the study from the department of General Surgery, All India Institute of Medical Sciences, Bhopa. The analysis done using the chi-square or Fisher's exact test. *P* values < 0.05 were considered significant. The outcomes were compared with the pre-existing standard protocols using SPSS.

Results: Among the 129 patients, 104 were COVID-19-negative and 15 were COVID-19-positive, and in 10 cases, the results were inconclusive. The abdominal presentations observed in the study were as follows: two patients with hemorrhagic and five with septic shock. Emergency surgeries were done in 80 (62.1%) patients, and conservative approaches were used in 49 (37.9%) patients; of the 80 patients who underwent operation, 30 (37.5%) required deviation from standard established protocols. The ICU admitted a larger number of COVID-19-positive patients as compared to COVID-19-negative patients [8 (57%) vs. 24 (25%)] who needed operations, and 18 (13.9%) patients were treated conservatively in the ICU. Mortality was higher in COVID-19-positive as compared to COVID-19-negative patients [4 (28%) vs. 9 (8%)].

Conclusion: The present study demonstrated the definite negative impact of COVID-19 on emergencies but provided useful lessons for emergency surgeons. A high standard of care, such as evaluating if a procedure can be postponed till the patient is less infectious or at a lesser risk of morbidity and mortality, is warranted during COVID-19 or similar pandemics. Ensuring adequate safety measures in the operating theatre is essential. We recommend a careful and judicious evaluation of every surgical indication.

Keywords: COVID-19, RT-PCR, SARS CoV-2, Acute abdomen, Mesenteric ischemia

Introduction

COVID-19 is a global pandemic disease caused by severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) (1). The virus outbreak started in China's Wuhan city in December 2019 and then spread globally. The World Health Organization (WHO) declared it a pandemic on March 11, 2020 (1). The treatment of COVID-19 during the initial period posed significant challenges due to the lack of knowledge about the disease, diagnosis, and treatment. Initially, the non-availability of a definite cure, vaccine, or methods to curtail its spread posed a significant challenge, disrupting the global public health systems. The initial diagnosis is done by RT-PCR and chest computed tomography (CT). However, in a later period, serum antibody and antigen detection tests and detection of SARS-COV-2 viral proteins in nasopharyngeal and oropharyngeal secretions were used (2,3). The COVID-19 pandemic altered the treatment pattern and patient flow in healthcare centers, and there was a complete change in the management of surgical patients. Preferences for elective surgeries were deferred; only emergency and oncologic surgeries were performed with changes according to COVID-19 protocols (4,5).

Global data showed a significant reduction in overall emergency department (ED) visits during the COVID-19 pandemic (6-8). Furthermore, a delay in ED visits has a negative impact on the treatment of oncology patients in critical situations (9). Previous study reports during the COVID-19 pandemic have shown decreased abdominal surgical ED admissions and patients presenting with severe abdominal conditions based on clinical, radiological, and pathological evidence (10,11).

In addition, ED visits for children also decreased during the COVID-19 pandemic in many countries

(12,13). In addition, analyzing pediatric ED visits during isolation is very important since they are mediated by different pathological conditions, including injury, communicable diseases, and time-sensitive emergencies such as appendicitis and sepsis. Against this backdrop, the study evaluated the profile and outcome of all abdominal emergencies presented to our hospital.

Methods

This was an observational study to evaluate the profile and outcome of all the abdominal emergencies presenting to the department of surgery, AIMS, Bhopal, during the pandemic period from 1st March 2020 to 31st March 2022. Before commencing the study, permission to conduct and publish this study was acquired from the Institutional Human Ethical Committee under permit number 2020/PG/Jan/12 issued on November 17, 2020.

Adult and pediatric patients with abdominal emergencies, including abdominal trauma, referred or otherwise, who consented to participate in the study were included.

Urological, gynecological, and medical abdominal emergencies were excluded.

The changes and modifications from non-pandemic times were recorded, and their outcomes were assessed. The patients were assessed and resuscitated while maintaining COVID-19-appropriate precautions. The patient's relatives were informed about the study using a patient information sheet explaining the study in their language in order to obtain their consent. Once consent was obtained, details of patient history were recorded. This included their travel history, COVID-19 contact, and any symptoms of influenza-like illness (ILI) or severe acute respiratory infections (SARI). The patients were clinically examined, and findings were recorded in the proforma and the datasheet. Routine investigations were performed. In all patients, RT-PCR tests for COVID, chest X-ray, CT of the thorax, and CT of the abdomen and pelvis were done depending on the availability of resources. Specific investigations were done to rule out medical, urological, obstetrical, and gynecological problems. Deviation from standard protocols was recorded. In those patients for whom non-operative management (NOM) was chosen, details of indications, alternative management, and necessary pathological, biochemical, microbiological, and radiological investigations were recorded. The decision to continue or discontinue NOM was made depending on the response.

Patients were assessed for primary and secondary outcomes. Primary outcome measures included hospital discharge and 30-day mortality. Secondary outcome measures included length of hospital stay, duration of ICU admission, surgical complications, and pulmonary complications.

Sample size: As this was an observational study, all the patients were recruited unless they met the exclusion criteria. The sample size was calculated using the formula below.

$$Sample\ size = \frac{Z^2 PQ}{d^2}$$

Where $Z = Z$ value at 95% confidence interval (1.96); P = prevalence in % (5.76); $Q = 100 - P$ (94.24); and d = standard error (5%)

The calculated sample size was 81. After taking into account a nonresponse rate of 10%, the sample size was 91.

After considering their inclusion criteria, the number of patients included was 129. Quantitative data were expressed as median, mean ± standard deviation, and range, while qualitative variables were reported as numbers (proportions, %). The difference in qualitative variables between different groups was evaluated by the chi-square or Fisher's exact test. Quantitative data were analyzed by paired and unpaired *t*-tests. *P*-values < 0.05 were considered significant.

The management outcome was measured by variables like length of hospitalization, length of ICU stay, and 30-day mortality.

Outcomes were compared with the pre-existing standard protocols using Statistical Package for the Social Sciences (SPSS) software.

Results

Among the 129 patients recruited, 84 were male, 45 were female, and most of the patients ($n = 27$) were 32–40 years old. Of 129 patients, 105 were adults, and 24 were pediatric patients. The majority of the emergency cases were non-COVID-19 (80.2%), and the distribution pattern of patients based on COVID-19 status was positive 15 (11.63%), negative 104 (80.62%), and inconclusive 10 (7.5%). Among the 24 pediatric patients, 1 (0.78%) was positive for COVID-19, 20 (15.5%) were negative, and 3 (2.33%) were inconclusive. The incidence of emergencies was higher in males than females (62.85% vs. 37.14%). The primary symptom related to abdominal emergency was abdominal pain in 122 (94.57 %) of the patients.

In this study, out of 129 patients, 80 (62%) underwent surgery, and among these, 54 (41.8%) had immediate surgery, and 26 (20.1%) had clinical and biochemical deterioration followed by surgery.

Appendicitis was present in 14 (13.3%) patients, 10 adults and 4 pediatric cases. Seven of the 10 adults had uncomplicated appendicitis. COVID-19 was observed only in 3 patients and they were managed conservatively. One COVID-19-positive patient had an appendicular lump with an abscess and required open drainage and an ICU stay.

Abdominal trauma was seen in 10 (9.52%) patients. Two of these patients had blunt trauma abdomen, of whom two were COVID-19-positive. One COVID-19-positive patient

had a duodenal laceration along with bleeding from the omentum. He required postoperative ICU for pneumonia, septic shock, Acute Renal Failure (ARF), and multiple organ dysfunction syndrome and finally succumbed to death. Another, who had grade IV splenic trauma, underwent operations with unknown status and was later found to be COVID-19-positive; however, the splenectomy was uneventful. Both of the penetrating trauma cases were COVID-19-negative. One had a bull-horn injury with bowel evisceration, and another had a stab with peritoneal breach. Both underwent surgery and were discharged uneventfully. We did not encounter any cases of domestic violence.

Two non-COVID-19 cases of blunt trauma could not be saved. One patient had a splenic injury, for which surgery and embolization were performed. The second had splenic and mesenteric injuries, for which splenectomy and ileostomy were performed. This patient developed burst abdomen postoperatively and had a Bogota bag (Figure 1) put, but succumbed to death after 15 days.

Three cases were managed conservatively. One, a case of blunt trauma with delayed presentation with bleeding in a grade 4 splenic injury (ruptured splenic artery pseudo-aneurysm), had multiple co-morbidities and was managed uneventfully with selective angio-embolization of the splenic artery. Two cases with lower grades of liver injury were managed conservatively.

Complicated gall bladder disease was seen in 20 (19.05%) patients: 9 had acute calculous cholecystitis, 9 had acute gallstone pancreatitis, and 2 cases had gall bladder perforation. Six cases of calculous cholecystitis and 2 cases of gall stone pancreatitis were COVID-positive. Both COVID-19-positive patients with gall stone pancreatitis, succumbed to the disease. The 2 cases of gall stone perforations were non-covid cases and were successfully managed with interventional radiology using PCD insertion, and both did well.

Cholangitis was seen in 3 (2.86%) patients. In 2 of them, the cause was biliary outflow obstruction due to tumors, and 1 had cholangitis due to an adult choledochal cyst. All three cholangitis cases were COVID-19-positive. All the patients were managed conservatively, and oncological referral was done for 2 cases.

Figure 1. Showing Bogota's bag for post-op burst abdomen in a case of trauma

Complicated ventral hernia was seen in 6 (5.71%): one tested positive for COVID-19; four of the patients had strangulation (1 COVID-19-positive), and two were obstructed. All the patients underwent operations. Definitive repair, i.e., mesh hernioplasty, was done in obstructed hernias, and the rest had anatomical repair.

Liver abscess was present in 4 (3.1%) patients (1 COVID-19-positive). One COVID-19-negative patient had a splenic abscess. All were managed with ultrasound-guided drainage procedures.

Acute mesenteric ischemia was seen in 6 (5.71%) patients, with 4 COVID-19-positive cases; one patient had acute mesenteric ischemia in a diagnosed case of polyarteritis nodosa and was managed with anticoagulants and discharged. Five other patients had operations, of whom 4 were admitted to the ICU and finally succumbed to death. One case underwent laparotomy with resection of gangrenous bowel and ileostomy and was discharged after complete recovery. One patient was suffering from gangrene due to a bucket handle mesentery injury and had a successful surgery (Figure 2).

Acute intestinal obstruction was present in 14 (13.3%) patients. Of these cases, 2 were COVID-19 positive and were managed conservatively and discharged after a hospital stay of 6.5 days. Three patients had surgery. Nine patients were initially treated conservatively but required conversion to surgery within three days. The postoperative ICU stay was ten days in all.

Perforation peritonitis was present in 23 (21.9%) patients. Twenty-one out of 23 patients were operated within 12 hours of presentation. One patient was COVID-19-positive and presented 12 days after the onset of symptoms and was resuscitated and managed conservatively along with USG-guided pigtail insertion.

Four patients were managed with interventional radiological procedures and 18 had non-radiological interventions. 2 out of the 4 cases managed radiologically and 1 out of the 18 patients from the non-radiological procedure group succumbed to death. The number of postoperative ICU admissions was higher for the radiological intervention group compared to the non-radiological group. The mean hospital stay was also significantly higher in the radiological group (16.35 days vs. 28.00 days) (P value = 0.6).

Perforation peritonitis was seen in 4 patients, and all were COVID-19-negative and underwent surgery. One patient developed pneumonia and Surgical Site Infection (SSI) during postoperative ICU care and required 25 days of hospitalization.

Acute appendicitis was seen in 4 patients, 2 of whom

were asymptomatic COVID-19-positive. One was uncomplicated, and 3 were complicated. Uncomplicated appendicitis was managed conservatively. All the complicated cases of appendicitis underwent surgery.

Intestinal obstruction was found in 3 non-COVID-19 patients; two cases required surgery, and 1 case was managed conservatively. One patient had resection and anastomosis with uneventful recovery. Another patient had a closed loop obstruction, for which resection of the diseased segment with end ileostomy and laparostomy was performed. During the postoperative period, the patient required an ICU stay and developed fever, abdominal distension, and guarding with pus flakes in abdominal drains. Re-exploration with resection of gangrenous bowel and a double barrel stoma with mesh laparostomy was performed. The patient had a prolonged ICU stay of 19 days and was finally discharged 52 days later after full recovery.

Three cases of Hirschsprung disease presented as emergencies. All were COVID-19-negative, and all underwent sigmoid colostomy.

Two non-COVID-19 cases had intussusceptions (Figure 3). In one, Ultrasound-guided hydro-reduction was performed three times, and after the patient developed symptoms again, he underwent surgery with uneventful post-op recovery.

Two patients with choledochal cysts, both COVID-19-negative with recurrent cholangitis, underwent semi-urgent surgery for the excision of the choledochal cyst with hepaticojejunostomy and were discharged after complete recovery.

Two non-COVID-19 cases of liver abscess were observed and managed conservatively.

Gallstone pancreatitis was seen in 1 non-COVID-19 case and was managed conservatively.

One case of COVID-19-negative child with biliary atresia underwent semi-urgent surgery during the COVID-19 peak. The patient underwent the Kasai procedure and was discharged after a hospital stay of 14 days.

Meconium ileus with ileal atresia was seen in 1 non-COVID-19 case with type 1 ileal atresia. He underwent laparotomy with resection and anastomosis of the mid-ileum and ileostomy. The patient developed pneumonia during the operative period and required seven days of

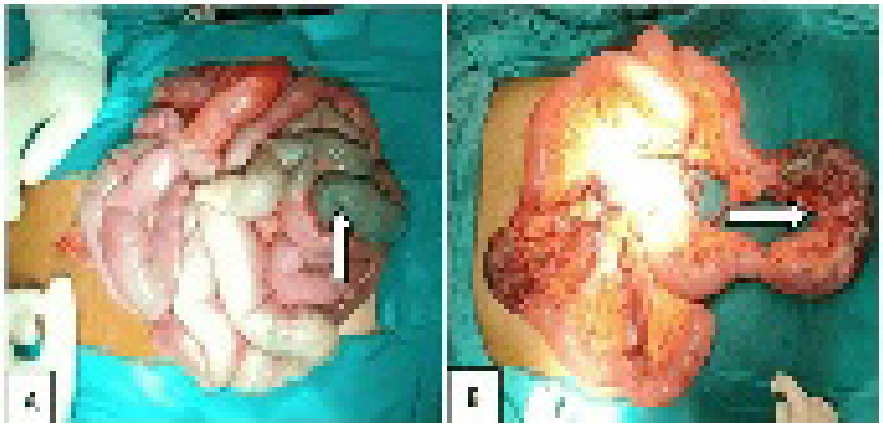

Figure 2. A. Intra-operative picture of gangrenous bowel in a case of acute mesenteric ischemia and B. Showing bucket handle injury with gangrenous bowel in a patient of blunt trauma

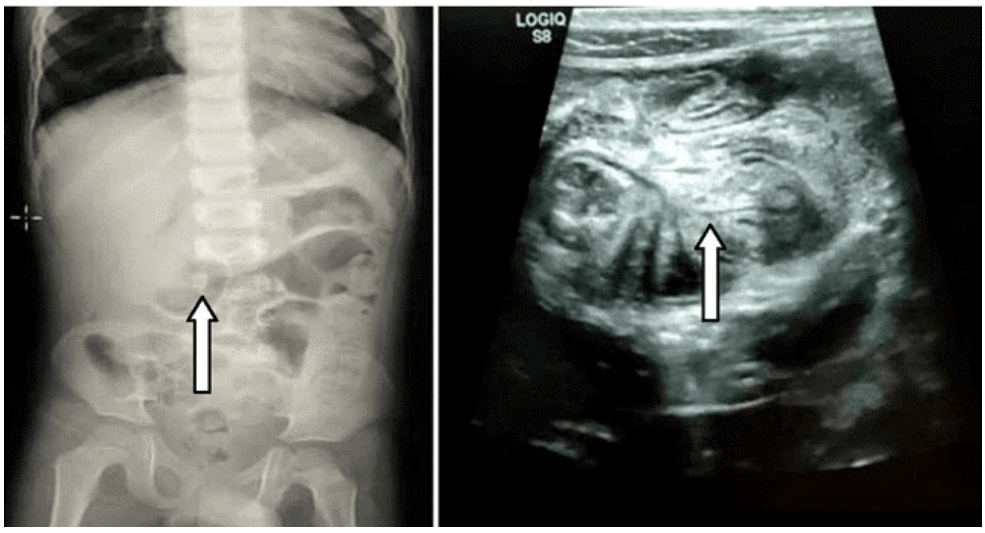

Figure 3. A. X-ray abdomen of intussusception of the pediatric patient. B. USG showing target sign

ICU stay.

Megacystis and intestinal hypoperistalsis syndrome was seen in 1 non-COVID-19 patient. The patient underwent transverse colostomy.

The postoperative complications among COVID-19-positive adults and the pediatric population are shown in Table 1. In COVID-19-positive patients, 4 cases died, and in pediatric cases, no mortality was observed. The incidence of postoperative complications was higher in adults than in pediatric cases (20.83% vs. 0%).

The postoperative complications among COVID-19-negative adults and the pediatric population are shown in Table 2. Fischer's exact test was used, and numbers were expressed in percentages. The incidence of postoperative complications was significantly higher in non-COVID-19 adults compared to pediatric cases (41.98% vs. 13.04%; $P=0.02$).

Among COVID-19-positive patients, 8 required ICU admission and 6 patients did not. In COVID-19-negative patients, 24 required ICU admission, whereas 72 did not. Eighteen patients were kept in the ICU but did not undergo surgery. In the pediatric age group, 7 patients, including the only COVID-19-positive case, required ICU admission.

Out of 80 cases who underwent surgery, the treatments of 30 patients deviated from standard established protocols (under normal non-covid circumstances), where definitive surgery would have been the best and the first choice. Damage control surgeries were done in the place of definitive surgeries. Interventional radiological procedures were done wherever possible to avoid surgeries. Among pediatric patients, the treatments of 6 out of 18 (37.5%) deviated from standard protocol. The treatments of 24 out of 59 patients deviated from standard protocol in adult patients, which has been discussed in detail earlier (Figure 4).

Table 1. Comparison of outcomes and complications in COVID-19-positive adults and pediatric patients

Characteristic	Adult, $n=24$[1]	Pediatric, $n=1$[2]	*P* value[2]
	n (%)	n (%)	
Outcome of patient			
Death	4 (16.67)	0 (0.00)	>0.9
Discharged	20 (83.33)	1 (100.00)	>0.7
Postoperative complication	5 (20.83)	0 (0.00)	>0.9
Anastomotic leak	0 (0.00)	0 (0.00)	-
Pneumonia	3 (12.50)	0 (0.00)	>0.9
Multiple organ dysfunction syndrome	3 (12.50)	0 (0.00)	>0.9
Septic shock	3 (12.50)	0 (0.00)	>0.9
Burst abdomen	0 (0.00)	0 (0.00)	-
Bedsores	0 (0.00)	0 (0.00)	-
Pleural effusion	1 (4.17)	0 (0.00)	>0.9

[1]Number of patients [2]Fisher's exact test

Discussion

Globally, a substantial decrease in abdominal emergencies was noted during this period, as confirmed in Italy, the USA, Spain, and also in our series (5). Nearly half of COVID-19 infected patients were asymptomatic for COVID-19 in other countries, while in our study, only 15% of cases were asymptomatic. This was possibly because the predominant population here was rural and less severely affected by the virus. Restrictions imposed on the entry of attendants and relations led to decreased hospital attendance. The incidence of trauma cases presenting to the emergency had also decreased worldwide (5). The reason was the prolonged duration of lockdowns, reducing road traffic hazards. In our study, unlike Western reports, we did not encounter any cases of domestic violence or abuse (14).

We initially tried managing stable trauma patients conservatively depending on the grade of injury according to the American Association for the Surgery of Trauma (AAST) and depending on the availability of Operation theatre (OT) facilities. Patients with lower grades of injury were managed conservatively. Patients with higher

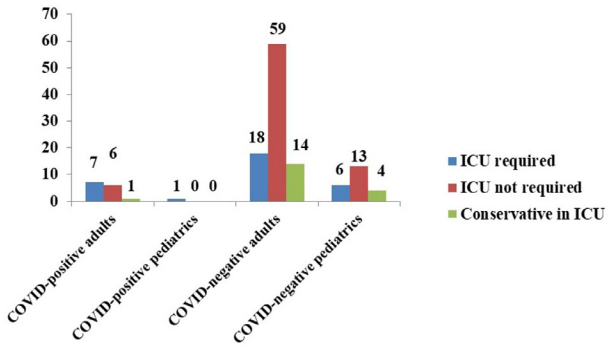

Figure 4. Details of ICU stay

Table 2. Comparison of outcomes and post-op complications in COVID-19-negative adults and children

Characteristic	Adult, $n=81$[1]	Pediatric, $n=23$[1]	*P* value[2]
	n (%)	n (%)	
Outcome of patient			
Death	9 (11.11)	0 (0.00)	0.2
Discharged	72 (88.89)	23 (100.00)	0.2
Incidence of post-op complication	34 (41.98)	3 (13.04)	0.022
Surgical site infection	13 (16.05)	3 (13.04)	>0.9
Anastomotic leak	2 (2.47)	0 (0.00)	>0.9
Pneumonia	4 (4.94)	0 (0.00)	0.6
Multiple organ dysfunction syndrome	3 (3.70)	0 (0.00)	>0.9
Septic shock	6 (7.41)	0 (0.00)	0.3
Burst abdomen	6 (7.41)	0 (0.00)	0.3
Bedsores	2 (2.47)	0 (0.00)	>0.9
Pleural effusion	4 (4.94)	0 (0.00)	0.6

[1]Number of patients [2]Fisher's exact test

grades of injury were still managed conservatively with caution, and where required, interventional radiological procedures and surgical management were done. One case of splenic trauma with a grade 4 injury that would otherwise have 100% indication for exploration was deferred and treated with interventional radiology support (14). We had only one mortality in a blunt abdominal trauma case. One patient of penetrating trauma who presented with evisceration of the bowel and omentum was promptly admitted for surgery and did well postoperatively. Penetrating abdominal trauma cases were managed with surgery.

In our study, gallbladder diseases and their complications showed an increased incidence, contrary to global reports (15,16). Both acute cholecystitis and acute gallstone pancreatitis were seen, which could have been due to neglect of gallstone disease and suspension of elective surgeries. The expression of abundant ACE 2 receptors in the gallbladder (16) has led to new ideas related to coronavirus cholecystitis. Case reports say that COVID-19 infection could mimic cholecystitis, which has been demonstrated by viral RNA in the gallbladder wall (16). In our study, despite the high number of COVID-19-positivity in gall stone cases, because surgery was not performed, the viral load of the gall bladder specimen was not tested. One case of acalculous GB perforation with localized peritonitis was managed using radiology-guided drain insertion and antibiotics, consistent with previous reports (15).

Laparoscopic appendectomy is the gold standard treatment for acute appendicitis, except in patients with severe co-morbidities and other contra-indications (17). In symptomatology, 100% of our patients, like in other series, had right iliac fossa pain. In comparison, a higher percentage of patients in our series complained of nausea and vomiting as compared to the report by Aharoni et al (18). Tenderness and rebound tenderness/rigidity were noted in 83.3% and 55.5% of our patients and in 95.9% and 66.2% in their series, respectively. In recent years, there has been an upsurge in managing appendicitis conservatively. However, the COVID-19 pandemic in its initial phases had an associated fear of dissemination of viruses via the pneumoperitoneum to which the surgeons were exposed. Likewise, the World Society of Emergency Surgery (*WSES*) Jerusalem guidelines and the 2020 update considered it appropriate to use non-operative management (NOM) in selected patients (adults or children) with uncomplicated appendicitis. The WSES guidelines informed the patients about the risk of recurrence (which was about 39%) (17,18). An additional advantage of NOM is that under supervision, the risk of perforation does not increase, and later recurrences are not complicated (19,20). The local complications of lumps that develop into abscesses can be dealt with well with percutaneous drainage and interval appendectomy. With our knowledge of conservative management, it was not very difficult to opt for it in such crucial times. The incidence in our experience was far less compared to other reported series. Male preponderance was noted in other series, while ours had a predominance of females. Most of the uncomplicated cases of appendicitis were noted in COVID-19-positive patients, which is in line with earlier reports (18,19,21).

In contrast, Frankcombe et al (22) reported a higher incidence of uncomplicated appendicitis (93% in COVID-19-negative patients). Like in other studies, complicated appendicitis was higher in the COVID-19 group in our study. Except for English et al, most other series opted for open appendectomies, like we did, due to policies against laparoscopy, which prevailed for a long time. Conservative management was provided for 55.5% of our cases and for 64.5% of patients in English and colleagues' series (20). The presentation of appendicitis was different in the present study, and the approach was case-dependent. The majority of the patients did not prefer the laparoscopic approach, and the percentage of patients presenting with appendicitis with COVID-19 were less severely affected than those with non-COVID-19 status (20).

Acute mesenteric ischemia was a topic of discussion during COVID-19, and it was caused by multiple factors. The COVID-19 virus had a known predilection for thrombotic phenomena, which required anticoagulant therapy in almost all who were severely affected (23-25). The patients who were COVID-19-positive had their mobility restricted owing to severe myalgia and fatigue, even in mild cases. Pre-existing co-morbidities were also a cause in those patients. The incidence of post-COVID-19 thrombotic phenomena was high, leading to strokes and myocardial infarctions even months later (24,25). Acute mesenteric ischemia is caused by insufficient blood flow through mesenteric vessels, resulting in ischemic changes within the bowel. The presentation is acute, severe abdominal pain, nausea, vomiting, anorexia, diarrhea, abdominal distension, and GI bleeding. In advanced stages, perforation with peritonitis results. Acute mesenteric ischemia has three types: arterial occlusion, venous occlusion, and non-occlusive mesenteric ischemia (26,27). Arterial occlusion is caused by embolism or thrombosis (27). Venous occlusion is mainly caused by thrombosis. Initial treatment is with revascularization therapies and anticoagulants. If a gangrenous bowel is present, resection of the gangrenous bowel is required (28-30).

Several hypotheses have been proposed to account for the connection between SARS-CoV-2 and gastrointestinal injury (31,32). The virus could up-regulate the expression of ACE-2 receptors, allowing deeper entry into gastrointestinal mucosal cells. The associated inflammatory response in these patients furthered the damage. The immunological damage, which was also a feature of this virus, was blamed for causing disruption

in the immune barrier of the gut, causing changes in the function and anatomy of the gut microbiota. Elevated von Willebrand factor was reported in these patients, capable of causing damage to the vascular endothelium, a seat for ACE-2 receptors (33). Together, these could induce mesenteric thrombosis, leading to ischemic bowel (34).

Moreover, hemodynamic shock with hypoxia, in itself, could result in ischemia of the gut. Hypercoagulable states were the hallmark disorder in COVID-19 patients. Kaafarani et al (31) and Bhayana et al (32) observed a patchy, yellowish discoloration of the bowel serosa in the ischemic lesions they observed, as opposed to the usual purple or black color of the necrotic bowel. In our patients, this finding was absent. An Italian study in Milan also reported a higher incidence of venous and arterial thrombosis associated with SARS-CoV-2 (35).

We had only 6 cases of mesenteric ischemia. Four were COVID-19 cases, and two were not. Other series reported all the patients as COVID-19-positive. The average age of our patients was above 57.8 years, which was similar to the average age in other studies (33). The predominance of males was noted in the reported series while we had an equal male-to-female ratio. The presenting symptoms recorded were similar. Almost all studies noted an inclination towards operative management, and Norsa et al (35) showed contrasting results. The mortality rate in our study was the highest, probably because of the delay in presentation, while those already under supervision in other series fared better. Postoperative complications in our series were high, and sepsis was noted to be the cause of death in the 66.6% of patients who succumbed to the illness.

Perforation peritonitis presents as an acute abdomen. Management includes adequate resuscitation and emergency surgery. Abdominal drain placement prior to surgery while the patient is being resuscitated is often practiced. Preoperative drain placement was done in four out of 23 (17.3%) of our patients, and 2 of them died postoperatively. In a study by Jaiswal et al. (36), all 71 patients had preoperative drainage with a mortality rate of 32.39%. In our study, only extremely sick patients were pre-operatively drained. Also, we had a very small number of such cases to reach reliable conclusions.

Acute pancreatitis is primarily treated by physicians, unless there are associated gallstones, ampullary stenosis, sequelae like pseudocyst of the pancreas, or malignancy (37). Patients with acute pancreatitis typically present with nausea, vomiting, and epigastric pain that radiates to the back. A diagnosis of acute pancreatitis is based on the presence of two of the following three criteria: (a) characteristic abdominal pain, (b) elevated levels of serum amylase or lipase, or (c) characteristic findings on CT scan. Management mainly focuses on fluid resuscitation, pain management, and early enteral nutrition (37). We had 9 COVID-19-positive cases of pancreatitis; one only required USG-guided pleural aspiration of effusion in the ICU and recovered uneventfully. Another contracted COVID-19 during the hospital stay and eventually succumbed to it after undergoing surgery for peripancreatic collection. Yawar et al (37) reported a similar series of 43 cases where 2 (4.65%) patients were reported as COVID-19-positive, 5 (11.62%) required ICU stay due to organ dysfunction, and 3 (6.98%) had Acute respiratory distress syndrome (ARDS) and succumbed to death. ARDS and being COVID-19-positive may have been the cause of mortality.

The most common surgical complication seen in our postoperative cases was SSI (12.4%). We found that though utmost precautions were taken for self-protection, sterility was still compromised, probably due to changes in clothes worn during the pandemic. Postoperative respiratory complications were about 7%. Burst abdomen was encountered in 5% of cases. The duration of hospital stay was increased, but ICU stay was decreased in the conservatively treated group compared to the operated group, though there was a significant difference. The reason might be that conservative approaches were adapted and as a result, they became more tedious and time-consuming than routine surgical interventions. There could also have been a statistical bias because we had fewer patients who underwent surgery in our series compared to other studies. In our study, the failure of NOM was 26 out of 75 (34.67%). Pediatric abdominal emergencies during COVID-19 suffered a significant setback. Parents were reluctant to bring in their children for consultations or surgical procedures for fear of getting infected themselves, and possibility of the child dying due to the pandemic of COVID. The fear of being isolated if tested positive, not being allowed to visit their child, and the fear of infecting the sick child were other sources of concern. Many times, patients refused to consent to surgery and left the hospital after witnessing the death of other patients in the ward.

There was great mental stress on the caretakers of these children as well as on the treating surgeons and their team. In a study from Spain, this aspect was addressed effectively (38,39). The number of pediatric emergencies in EDs in Spain dropped significantly, and the number of visits decreased by 84.5%. The mean age of the children treated during the pre-COVID-19 phase was 5.93 years in the same study with (median 5, SD 4.41, IQR 2–10 years) versus 4.44 years (median 3, SD 4.24, IQR 1–8 years) during the COVID-19 phase (5). Similar to our study, the cases in their study consisted of 36.2% females and 63.7% males. Only 13.95 % of emergencies were in the pediatric population during this phase, and only one COVID-19-positive child was treated. We encountered different types of abdominal emergencies, and in 70.8% of children, surgeries were unavoidable. The results and outcomes were better in the pediatric patients than in adults. The

children had minimal postoperative complications (23% in children vs. 37.14% in adults) and no mortality (12.38% mortality was noted in adults). Unlike in adults, the incidence of complicated appendicitis was higher in pediatric COVID-19 patients, which is in line with the series by Schafer et al (39). The smaller number of patients did affect our comparative tally. However, in our series, 3 out of 4 (75 %) had complicated appendicitis, compared to 49 out of 176 (27.8%) in their study. There were no COVID-19-positive cases reported by Schafer et al (39).

The management of Hirschsprung disease is one-stage or two-stage surgery. Our protocol is two-stage surgery. During the pandemic, however, rectal washings were given frequently to buy time for surgery. A colostomy was done on a semi-urgent basis, and then definitive surgery was planned and postponed for a later date.

Even though biliary atresia and choledochal cysts are to be operated on an elective basis, our center performed this operation on a semi-urgent basis because of complications (recurrent cholangitis) and associated morbidities.

The outbreak of the COVID-19 pandemic especially affected the surgical specialties. Routine surgeries came to a total halt, and emergencies required serious modifications because of the diversion of amenities to the seriously ill COVID-19-affected population. An essential section of surgical emergencies is acute abdomen and abdominal trauma, which demands urgency and accuracy in diagnosis as well as management. Surgical abdomen is caused by inflammatory, infective, obstructive, vascular occlusive pathologies and trauma. Patients present with sudden onset abdominal pain associated with nausea and vomiting, distension of the abdomen, cessation of bowel functions, or a history of trauma. Dexterity in history-taking, examination, and ordering appropriate investigations is key to diagnosis as although it may present in an obvious or, at times, subtle manner, it needs to be promptly identified. This requires investigations and concomitant resuscitative therapy to start immediately, and, at times, even early surgical intervention as a life-saving measure becomes mandatory.

The aim during this pandemic was, and should always be, twofold: 1) Performing emergency surgery in a safe and protected environment for surgical patients, offering the best management while following COVID-19 protocols, and 2) Safeguarding the healthcare workers under COVID-19 so as not to cause mass-scale spread of the virus among the workforce, leading to a collapse of the system. The patient's clinical condition, the nature and severity of the disease, and the availability of IR facilities dictated the change in management protocol. With the COVID-19 pandemic, significant, earlier unheard of, or not-commonly-practiced options in managing abdominal emergencies, some successful, others not, were carried out. Infective etiologies were given the option of conservative management. Although the hospital stay was prolonged with interventional radiological procedures, they gave us the chance to explore newer avenues of treatment. These modifications proved effective in acute crises where conscious postponing of surgeries were required.

Policies declaring us as a 'COVID-19 hospital' led to increased stigma for the patients, and the routine flow of emergency patients was seriously affected. The major drawback we faced in this study was the inherent nature of the pandemic, which made us work as single-surgeon teams to safeguard the surgeons and anesthesiologists from the virus. The overall number of emergency patients was smaller during this pandemic, and the patients for one particular diagnosis were very few. Hence, definitive and appropriate comparisons with other studies may be inaccurate. Often, desired investigations as per our study protocol were not available. We were selective in doing only the essential sections of the requirements for our study protocol.

Conclusion

Abdominal surgical emergencies include traumatic as well as non-traumatic surgical emergencies. The term acute abdomen includes various surgical diseases and medical, gynecological, and urological causes. The surgical acute abdomen includes acute intestinal perforations, acute intestinal obstruction, vascular emergencies, i.e., acute mesenteric ischemia, inflammatory and infective etiologies like acute cholecystitis, acute appendicitis, acute diverticulitis, liver, splenic and other abdominal abscesses, etc. Managing acute abdominal emergencies depends on the patient's clinical condition, the disease's nature and severity, and the availability of IR facilities.

With the COVID-19 pandemic, earlier unheard-of or not-commonly-practiced options for managing abdominal emergencies were carried out. Infective etiologies like acute appendicitis, acute cholecystitis, and complicated splenic and liver abscesses were always given an option of conservative management. Interventional radiology facilities helped us explore newer avenues. These can be considered effective measures in acute crises where conscious postponing of surgeries is required.

Our study accounts for the definite negative impact of COVID-19 on emergencies; however, it provided lessons for emergency surgeons on dealing effectively with cases during such pandemics. A high standard of care during COVID-19 or similar pandemics is warranted, like evaluating if a procedure can be postponed till the patient is less infectious or at a lesser risk of morbidity and mortality. Trained OR staff, appropriate instruments, and strict adherence to endorsements are essential to avoid the risk of contamination. In case of lack of skills or suitable instrumentations for safe laparoscopic surgical intervention, laparotomy is always preferred. It has to be kept in mind that in such pandemics, healthcare workers are overwhelmed, and ICUs are overcrowded

as respiratory support is diverted to care for COVID-19 patients. Therefore, we recommend cautiously assessing all surgical warnings.

Acknowledgments

None.

Authors' Contribution

Conceptualization: Bharati Pandya, Reyaz Ahmad, Ajeet Maurya.
Data curation: Vishnu Vardhan P. Reddy, Srujan Dharap, Ajeet Maurya.
Methodology: Vishnu Vardhan P. Reddy, Srujan Dharap.
Project administration: Bharati Pandya, Reyaz Ahmad, Ajeet Maurya.
Supervision: Bharati Pandya, Reyaz Ahmad, Ajeet Maurya, Meena Kumari.
Validation: Bharati Pandya, Reyaz Ahmad, Ajeet Maurya, Meena Kumari.
Writing–original draft: Vishnu Vardhan P. Reddy, Srujan Dharap.
Writing–review & editing: Bharati Pandya, Reyaz Ahmad, Ajeet Maurya, Meena Kumari.

Competing Interests

None.

Ethical Approval

This study was approved by the Institutional Human Ethical Committee under permit number 2020/PG/Jan/12 issued on November 17, 2020.

Funding

None.

References

1. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med. 2020;382(8):727-33. doi: 10.1056/NEJMoa2001017.
2. Kovács A, Palásti P, Veréb D, Bozsik B, Palkó A, Kincses ZT. The sensitivity and specificity of chest CT in the diagnosis of COVID-19. Eur Radiol. 2021;31(5):2819-24. doi: 10.1007/s00330-020-07347-x.
3. Parasher A. COVID-19: current understanding of its pathophysiology, clinical presentation and treatment. Postgrad Med J. 2021;97(1147):312-20. doi: 10.1136/postgradmedj-2020-138577.
4. Deo SV, Kumar S, Kumar N, Saikia J, Bhoriwal S, Bhatnagar S, et al. Guiding principles for cancer surgery during the COVID-19 pandemic. Indian J Surg Oncol. 2020;11(Suppl 1):3-10. doi: 10.1007/s13193-020-01082-x.
5. María FM, Lorena MR, María Luz FV, Cristina RV, Dolores PD, Fernando TF. Overall management of emergency general surgery patients during the surge of the COVID-19 pandemic: an analysis of procedures and outcomes from a teaching hospital at the worst hit area in Spain. Eur J Trauma Emerg Surg. 2021;47(3):693-702. doi: 10.1007/s00068-020-01558-z.
6. Honeyford K, Coughlan C, Nijman RG, Expert P, Burcea G, Maconochie I, et al. Changes in emergency department activity and the first COVID-19 lockdown: a cross-sectional study. West J Emerg Med. 2021;22(3):603-7. doi: 10.5811/westjem.2021.2.49614.
7. Steinman M, de Sousa JH, Tustumi F, Wolosker N. The burden of the pandemic on the non-SARS-CoV-2 emergencies: a multicenter study. Am J Emerg Med. 2021;42:9-14. doi: 10.1016/j.ajem.2020.12.080.
8. Jeffery MM, D'Onofrio G, Paek H, Platts-Mills TF, Soares WE, 3rd, Hoppe JA, et al. Trends in emergency department visits and hospital admissions in health care systems in 5 states in the first months of the COVID-19 pandemic in the US. JAMA Intern Med. 2020;180(10):1328-33. doi: 10.1001/jamainternmed.2020.3288.
9. Martellucci J, Damigella A, Bergamini C, Alemanno G, Pantalone D, Coratti A, et al. Emergency surgery in the time of coronavirus: the pandemic effect. Minerva Surg. 2021;76(4):382-7. doi: 10.23736/s2724-5691.20.08545-4.
10. Romero J, Valencia S, Guerrero A. Acute appendicitis during coronavirus disease 2019 (COVID-19): changes in clinical presentation and CT findings. J Am Coll Radiol. 2020;17(8):1011-3. doi: 10.1016/j.jacr.2020.06.002.
11. Vissio E, Falco EC, Scozzari G, Scarmozzino A, Trinh DA, Morino M, et al. The adverse impact of the COVID-19 pandemic on abdominal emergencies: a retrospective clinico-pathological analysis. J Clin Med. 2021;10(22):5254. doi: 10.3390/jcm10225254.
12. Kundal R, Singh R, Kant V, Pandey M, Sarin YK. Perioperative course of COVID-19 in pediatric patients undergoing emergency surgeries. J Indian Assoc Pediatr Surg. 2022;27(5):561-4. doi: 10.4103/jiaps.jiaps_209_21.
13. Pines JM, Zocchi MS, Black BS, Carlson JN, Celedon P, Moghtaderi A, et al. Characterizing pediatric emergency department visits during the COVID-19 pandemic. Am J Emerg Med. 2021;41:201-4. doi: 10.1016/j.ajem.2020.11.037.
14. Kumari M, Parwez M, Jain A, Pandya B. Management of a delayed, post-traumatic rupture of splenic artery pseudoaneurysm in a patient with life threatening co-morbidities: a treatment challenge. Int J Surg Case Rep. 2020;75:479-82. doi: 10.1016/j.ijscr.2020.09.083.
15. Date RS, Thrumurthy SG, Whiteside S, Umer MA, Pursnani KG, Ward JB, et al. Gallbladder perforation: case series and systematic review. Int J Surg. 2012;10(2):63-8. doi: 10.1016/j.ijsu.2011.12.004.
16. Date RS, Thrumurthy SG, Whiteside S, Umer MA, Pursnani KG, Ward JB, et al. Gallbladder perforation: case series and systematic review. Int J Surg 2012;10(2):63-8. doi: 10.1016/j.ijsu.2011.12.004.
17. Di Saverio S, Podda M, De Simone B, Ceresoli M, Augustin G, Gori A, et al. Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. World J Emerg Surg. 2020;15(1):27. doi: 10.1186/s13017-020-00306-3.
18. Aharoni M, Barash Y, Zager Y, Anteby R, Khalilieh S, Amiel I, et al. Management of acute appendicitis during the COVID-19 pandemic: a single tertiary center experience. Isr Med Assoc J. 2021;23(5):269-73.
19. Bajomo O, Hampal R, Sykes P, Miah A. Managing appendicitis during the COVID-19 era: a single centre experience & implications for future practice. Ann Med Surg (Lond). 2021;63:102168. doi: 10.1016/j.amsu.2021.02.014.
20. English W, Habib Bedwani N, Smith C, Doganay E, Marsden M, Muse S, et al. Suspected appendicitis and COVID-19, a change in investigation and management—a multicentre cohort study. Langenbecks Arch Surg. 2021;406(2):357-65. doi: 10.1007/s00423-020-02023-6.
21. Ganesh R, Lucocq J, Ekpete NO, Ain NU, Lim SK, Alwash A, et al. Management of appendicitis during COVID-19 pandemic; short-term outcomes. Scott Med J. 2020;65(4):144-8. doi: 10.1177/0036933020956316.
22. Frankcombe D, Gauri N, Satchithanandha V, Liang Y, Bak S, Suri T, et al. Management of acute appendicitis during the COVID-19 pandemic: a retrospective cohort study. BMC Surg. 2022;22(1):393. doi: 10.1186/s12893-022-01851-1.

23. Ahmed S, Zimba O, Gasparyan AY. Thrombosis in coronavirus disease 2019 (COVID-19) through the prism of Virchow's triad. Clin Rheumatol. 2020;39(9):2529-43. doi: 10.1007/s10067-020-05275-1.
24. Zhou Y, Li W, Wang D, Mao L, Jin H, Li Y, et al. Clinical time course of COVID-19, its neurological manifestation and some thoughts on its management. Stroke Vasc Neurol. 2020;5(2):177-9. doi: 10.1136/svn-2020-000398.
25. Wijeratne T, Sales C, Karimi L, Crewther SG. Acute ischemic stroke in COVID-19: a case-based systematic review. Front Neurol. 2020;11:1031. doi: 10.3389/fneur.2020.01031.
26. Escher R, Breakey N, Lämmle B. Severe COVID-19 infection associated with endothelial activation. Thromb Res. 2020;190:62. doi: 10.1016/j.thromres.2020.04.014.
27. Lodigiani C, Iapichino G, Carenzo L, Cecconi M, Ferrazzi P, Sebastian T, et al. Venous and arterial thromboembolic complications in COVID-19 patients admitted to an academic hospital in Milan, Italy. Thromb Res. 2020;191:9-14. doi: 10.1016/j.thromres.2020.04.024.
28. Kärkkäinen JM. Acute mesenteric ischemia: a challenge for the acute care surgeon. Scand J Surg. 2021;110(2):150-8. doi: 10.1177/14574969211007590.
29. Parry AH, Wani AH, Yaseen M. Acute mesenteric ischemia in severe coronavirus-19 (COVID-19): possible mechanisms and diagnostic pathway. Acad Radiol. 2020;27(8):1190. doi: 10.1016/j.acra.2020.05.016.
30. Pan L, Mu M, Yang P, Sun Y, Wang R, Yan J, et al. Clinical characteristics of COVID-19 patients with digestive symptoms in Hubei, China: a descriptive, cross-sectional, multicenter study. Am J Gastroenterol. 2020;115(5):766-73. doi: 10.14309/ajg.0000000000000620.
31. Kaafarani HMA, El Moheb M, Hwabejire JO, Naar L, Christensen MA, Breen K, et al. Gastrointestinal complications in critically ill patients with COVID-19. Ann Surg. 2020;272(2):e61-2. doi: 10.1097/sla.0000000000004004.
32. Bhayana R, Som A, Li MD, Carey DE, Anderson MA, Blake MA, et al. Abdominal imaging findings in COVID-19: preliminary observations. Radiology. 2020;297(1):E207-15. doi: 10.1148/radiol.2020201908.
33. Chen C, Li YW, Shi PF, Qian SX. Acute mesenteric ischemia in patients with COVID-19: review of the literature. J Natl Med Assoc. 2022;114(1):47-55. doi: 10.1016/j.jnma.2021.12.003.
34. Hwabejire JO, Kaafarani HM, Mashbari H, Misdraji J, Fagenholz PJ, Gartland RM, et al. Bowel ischemia in COVID-19 infection: one-year surgical experience. Am Surg. 2021;87(12):1893-900. doi: 10.1177/00031348211038571.
35. Norsa L, Bonaffini PA, Caldato M, Bonifacio C, Sonzogni A, Indriolo A, et al. Intestinal ischemic manifestations of SARS-CoV-2: results from the ABDOCOVID multicentre study. World J Gastroenterol. 2021;27(32):5448-59. doi: 10.3748/wjg.v27.i32.5448.
36. Jaiswal S, Sharma SC. Role of peritoneal drainage in moribund patients of perforation peritonitis. Int Surg J. 2020;7(5):1357-60. doi: 10.18203/2349-2902.isj20201535.
37. Yawar B, Marzouk A, Ali H, Asim A, Ghorab T, Bahli Z, et al. Acute pancreatitis during COVID-19 pandemic: an overview of patient demographics, disease severity, management and outcomes in an acute district hospital in Northern Ireland. Cureus. 2021;13(10):e18520. doi: 10.7759/cureus.18520.
38. Lázaro Carreño MI, Barrés Fernández A, Quintero García D, Ferrer Ferrer J, Fernández González I, Monfort Belenguer L, et al. Paediatric emergencies during the COVID-19 pandemic. Glob Pediatr Health. 2021;8:2333794x21989528. doi: 10.1177/2333794x21989528.
39. Schäfer FM, Meyer J, Kellnar S, Warmbrunn J, Schuster T, Simon S, et al. Increased incidence of perforated appendicitis in children during COVID-19 pandemic in a Bavarian multi-center study. Front Pediatr. 2021;9:683607. doi: 10.3389/fped.2021.683607.